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URINARY INFECTIONS: THEIR CLASSIFICATION*

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DISCUSSION *by Donald A. Charnock, M.D., Los Angeles; Charles P. Mathé, M.D., San Francisco; Lionel P. Player, M.D., San Francisco.*

NEPHRITIS and pyelonephritis are unsatisfactory representatives of two distinct groups of renal inflammation. The one refers to medical diseases of the kidney, the other to surgical, but the terms are not specific. Each covers many widely differing conditions and each group presents great difficulty in classification of these various diseases into recognizable and well-defined entities. Everyone should be familiar with the difficulties involved.

Fundamental differences of cause, mode and source of infection and of the clinical course and findings in relation to pathological changes establish a basis of division and subdivision, but in neither group can an etiological, anatomical, pathological or clinical basis of classification exclusively be followed to a satisfactory conclusion. But medical and surgical diseases are too complex and in themselves too closely interrelated to permit classification except on general lines. Transitional stages from one type to another are frequent.

The division into medical and surgical is itself misleading and nosologically incorrect. Some of the medical diseases often require surgery. In many surgical diseases operation is never indicated. The surgical group may be defined as including all renal lesions due to direct bacterial invasion, the medical group, degenerative inflammatory and vascular types of change secondary to toxins of the blood stream, whether chemical, bacterial, or other noninfectious cause. The origin of an infectious nephritis may be the same as an acute glomerulonephritis. Why the streptococcus, say of scarlet fever, at one time invades renal tissue, at another injures it indirectly through toxins (or antitoxins) is not known. Pyogenic infections may produce metastatic lesions of various types in the kidney or set free toxins that give rise to various forms of Bright's disease. An infectious fever may give rise to a specific focal infectious nephritis, or be the starting point of an acute or chronic nephritis, noninfectious, or if prolonged of a nephrosis, also noninfectious. The causes of the essential or nonrenal hypertensive group are unknown. Focal infection, therefore, is a very important factor of origin of both infectious and noninfectious lesions.

Nevertheless this division of inflammatory and degenerative renal lesions into an infectious or surgical group and a noninfectious or medical group is fundamental in diagnosis. The object of further discussion here is subdivision of the infectious group by classifying its many heterogenous types in such a way that they may be differentiated and recognized clinically.

Classification of Renal Infections (Surgical).—Any disease or abnormality of the urogenital tract has a tendency to produce urinary stasis or obstruction. Whenever this occurs, no matter how temporary, infection is imminent. These infections may come from the outside or from a lower portion of the tract, ascending; from the lymphatics, as cecum to right kidney, or from the blood, as in focal infections. It is not possible to determine always the source of infection. All three routes may be active together or variously at different times. But the important factor is lowering of local resistance. Trauma of any kind may do the same thing and an infection occur which would not have occurred without it. Any condition which impairs renal resistance as renal stone or faulty hygiene is an accessory of infection. A good primary division of renal infections, therefore, is into the following two types:

Type A.—Infections resulting from organisms which reach the kidney through the blood stream in overwhelming numbers, particularly virulent or specifically disposed.

Type B.—Infections resulting because of some urogenital abnormality or condition which acts to lower local resistance, or to furnish a portal of entry.

THREE CLINICAL GROUPS OF RENAL INFECTIONS

Classification into Type A depends on whether the urogenital tract is normal, and into Type B whether the abnormality is a factor of incidence. Particularly virulent overwhelming infections occur with marked abnormalities in which the abnormality probably had nothing to do with the onset. Only when the abnormality is an accessory of infection is it significant. With these facts and characteristics in mind, three distinct clinical groups of renal infections are recognizable:

I. The specific group.
II. The focal group, or Type A infections.
III. The urogenital group, or Type B infections.

* Read before the Section of Urology at the sixtieth annual session of the California Medical Association at San Francisco, April 27-30, 1931.

Pathologically, lesions in any one of these groups may be indistinguishable. Any pathological classification unrelated to clinical conditions is of little practical value. Pyelitis and pyelonephritis are too general and indefinite, not much better than the term "pyuria"; but qualifying each with the specific, focal or urogenital factor, which is directly related, will give definition and clinical meaning.

The pathological types of infection are generally grouped as follows:

Cystitis	Suppurative lesions
Cystopyelitis	Acute suppurative nephritis
Pyelocystitis	Multiple cortical abscesses
Pyelitis	Carbuncle
Pyelonephritis	Perirenal abscess
Acute	Perirenal and pararenal lesions
Chronic	Rare types of lesions
Atrophic	Cystica
Infected hydronephrosis	Granulosa
Pyonephrosis	Leukoplakia
Septic infarction	Malakoplakia

Only exceptionally do these lesions have definite clinical recognition. By qualifying the presumptive pathological lesion, which is indicated by the complete clinical and urological study, with an etiological factor of incidence also indicated by this study, accuracy of diagnosis, success in treatment, and a mutual basis of understanding is secured such that one doctor will know what the other one is talking about.

I. THE SPECIFIC GROUP

The specific group of renal infections includes those infections characterized by the causative agent as: (1) Renal tuberculosis. (2) Gonococcal nephritis. (3) Actinomycosis. (4) Syphilis (nephrosis). Everyone understands what is meant by the diagnosis of tuberculous pyelonephritis or pyonephrosis.

II. THE FOCAL GROUP

Relatively few pyogenic organisms invade the urinary tract. *Bacillus coli communis* and allied groups (such as Proteus vulgaris, aerogenes capsulatus, fecalis alcaligines, and pyocyaneus) predominate. Streptococcus and staphylococcus are relatively infrequent, but it is uncertain how infrequent. Both experimental and clinical results indicate it may at times be the primary invader with a colon-like organism secondary and outgrowing it (Hayden, Bumpus), but Helmholz was unable to produce colon infections in rabbits which had previously been inoculated with cocci. Here the colon did not outgrow cocci.

Limitation of Bacteriological Study.—Bacteriological studies of chronic pyelonephritis, particularly that secondary to urogenital obstruction, often give varying findings. Mixed infections occur. Take the following three cases, shown in Table 1, studied ten years ago, when bacteriological studies and vaccines were popular: Cases 1 and 3 show five different organisms; Case 2, four; and mixed infection is frequent in the others. Knowledge of the type of organism is important in the interest of a complete diagnosis, but not nearly so significant as knowing that organisms are present. The fact that it is a bacillus or coccus and the type of either is a matter for due consideration only after one has determined whether or not its presence is secondary to accessory urogenital conditions. The only renal infections in which knowledge of coccus or bacillus invasion is of great significance is in a subgroup of the focal group under discussion. Unfortunately it is just in this very subgroup that the urine most frequently is sterile and negative. The characteristic lesion in the kidney of this subgroup is due to a coccus, but as the lesion is cortical and does not communicate with the tubular system or pelvis, the urine is negative. The only time, therefore, when determination of the type of pyogenic organism in the urine would be of real diagnostic value, the organism does not reach the urine. At other times when the urine is loaded with organisms, the type of organism, whether bacillus or coccus, has no immediate significance of the nature of the renal lesion. At times cocci invade tubules and pelvis, and bacilli can produce cortical abscesses. Glomeruli and interstitial tissues, the favorite field for cocci, are not immune to bacillary invaders. Therefore the first consideration is not so much the type of organism as the presence of organisms and their probable source.

The blood stream is invaded by organisms from many different sources. The specific group given above is characterized by renal involvement with a specific organism (tubercle bacillus, gonococcus, etc.). The focal group is characterized by renal involvement with pyogenic organisms not as a rule intercurrent but late, even months after the acute stage of the original infection and this original focus may have been so transitory as to have been almost forgotten. Foci need not persist.

These focal sources of renal infection may for convenience be considered in relation to four systems: integumentary, respiratory, digestive, and miscellaneous sources. Integumentary foci are: infected wounds, boils, furuncles and carbuncles, erysipelas, impetigo, osteomyelitis, etc.

Respiratory foci are: otitis, mastoiditis, rhinitis, bronchitis, bronchopneumonia, pleurisy, etc.

Digestive foci are: angina, tonsils, teeth, appendix, gall-bladder, colon, visceral purpura, bowel stasis or faulty hygiene, etc.

Miscellaneous foci occur as pus tubes, etc. It is possible for infection anywhere to be a source of renal infection.

Streptococci and staphylococci (pneumococci) dominate integumentary and respiratory tract infections and such infections of the digestive system as angina tonsillitis and infected teeth; but cannot compete with bacillary or colon-like organisms in the remaining alimentary tract conditions which act as foci. The bacillus group also dominates urogenital types almost 90 per cent.

Although the mechanism of renal invasion from urogenital foci may be hematogenous or bloodborne in many cases just as from integumentary, respiratory and digestive system foci, this bacillary predominance and the difficulty often of determining whether renal involvement is hematogenous, lymphogenous or ascending makes it logical to consider all urogenital foci, whether

TABLE 1.—*Bacteriological Study of Three Cases*

Date	B. coli	Subtilis	Alcaligines	Aerogenes	Staphylococcus		Streptococcus		Sterile
					Albus	Aureus	Non-hemolytic	Viridans	
I. Young									
July 7, 1919	+	....	....	....	....	....	....	....	....
August 9, 1919	....	....	....	....	+	....	+	....	....
August 14, 1919	....	....	....	....	....	+	....	....	....
August 16, 1919	....	....	....	....	....	....	+	....	....
August 23, 1919	....	....	....	....	....	....	....	+	....
August 29, 1919	+	....	....	....	....	....	....	....	....
October 4, 1919	+	....	....	....	+	....	....	....	....
November 20, 1919	....	....	....	....	+	....	....	....	....
November 22, 1919	....	....	....	....	....	+	....	....	....
December 3, 1919	....	....	....	....	+	....	....	....	....
December 24, 1919	....	....	....	....	+	....	....	....	....
January 3, 1920	....	....	....	....	....	....	....	....	+
January 5, 1920	+	....	....	....	....	....	....	....	....
II. McAffee									
January 10, 1918	....	....	....	....	+	....	....	....	....
January 22, 1918	+	....	....	....	+	....	....	....	....
March 21, 1918	+	....	....	....	+	....	+	....	....
September 23, 1919	....	....	+	....	....	....	....	....	....
October 31, 1919	....	....	+	....	+	....	....	....	....
January 6, 1920	....	....	....	....	....	....	....	....	+
III. Tyler									
August 5, 1918	+	....	....	....	....	....	....	....	....
October 1, 1918	+	+	....	....	+	....	....	....	....
October 7, 1918	+	....	....	....	....	....	....	....	....
October 10, 1918	+	....	....	....	....	....	....	....	....
October 15, 1918	+	....	....	....	....	....	....	....	....
October 17, 1918	+	....	+	....	+	....	....	....	....
November 8, 1918	+	....	....	....	....	....	+	....	....
November 13, 1918	+	....	....	....	....	....	....	....	....
December 9, 1918	....	....	....	....	+	....	....	....	....
December 16, 1918	....	....	....	....	+	....	....	....	....
December 28, 1918	....	....	....	....	....	....	....	....	+

metastatic or not, in one group as accessories of infection along with obstruction or trauma. The route of infection is relatively unimportant anyway compared to the source. With the understanding that foci of infection of the urogenital tract below the kidney may feed organisms into the blood stream as other infections do, to be carried to the kidney and infect it, yet for the practical purpose of classification, these foci will be considered as a subdivision of urogenital sources of renal infection under the next or accessory group. The following outline will indicate their scope:

Urethral (instrumental injury with chill and sepsis, marital urethral injury, ascending from the outside—contamination from diapers in children, and from leukorrhea in women).

Prostatic and seminal vesicular (prostatitis and seminal vesiculitis).

Vesical (cystitis, submucous ulceration, pericystitis—ureteral reflux accompanying disturbed mechanism of urination).

Ureteral (ureteritis, periureteritis, stricture—reflux or obstruction).

Pelvic (pyelitis and peripyelitis, abscess—pyelovenous backflow).

Parenchymal (reinfection and exacerbations, intrarenal ascension).

Clinically, three characteristic groups of infections result from invasion of the normal kidney by organisms from the various above sources. The focal group, therefore, may be definitely subdivided into:

1. Pure coccal suppurative lesions.

2. Obscure forms of bacillary or mixed infection.

3. Intercurrent infection.

Subdivision 1. *Pure Coccal Suppurative Lesions.*—Pure coceal cortical infections form a distinct clinical entity. They commonly occur from streptococci or staphylococci of integumentary foci. They produce renal suppuration which may be diffuse; diffuse suppurative nephritis, local; multiple cortical abscesses and conglomerate, carbuncle. At the onset they are acute with hyperpyrexia, leukocytosis, and general intoxication. The urine is almost always negative, even to culture in the acute stage and frequently throughout the course of the disease which may last for months. They are usually unilateral. Sometimes, then, nephrectomy is life-saving. If not fulminating they may become chronic with frequent acute exacerbations, at which times renal tenderness may be marked, or they may go on to slow healing. These lesions are the commonest cause of perinephritic abscess.

The pathological terms define satisfactorily these clinical types of pure coccal suppurative infections. It is not often, however, that the surgeon can specify definitely before operation whether the lesion is a diffuse suppuration, multiple abscesses of the cortex, or a large carbuncle. No doubt, also, many of these patients go to healing without operation. But as a clinical group it is quite definite and best indicated clinically by associating the terms "coccal" and "suppuration" because other suppurative lesions of the kidney occur and other types of coccal infections occur.

Subdivision 2. *Obscure Focal Infections of Bacillary or Mixed Invasion.*—The focal renal infections form a heterogeneous group impossible of definite classification. They are recognized and diagnosed more through methods of exclusion than otherwise. The urogenital tract must be normal or any abnormality proven to be unrelated. They may be acute but, unlike the above cortical lesions of pure cocci, give immediate evidence in the urine by pus and bacteria. The bacillary infections in themselves, unlike the coccal, are never fatal at the onset. Unusually high temperatures occur. There is moderate to high leukocytosis. They tend to become chronic with periodic exacerbations. They are almost always bilateral. Removal of the focal infection early will cause them to disappear often without treatment. Otherwise atrophic changes develop with loss of renal function and renal insufficiency that during some exacerbation may develop into uremia.

These obscure cases without urogenital abnormality, which are also nonspecific and not of the pure coccal suppurative type, are difficult to recognize as well as classify clinically, but undoubtedly some attempt should be made to group different types of these focal infections. The terms "acute," "chronic" or "atrophic" pyelonephritis, qualified by the term "focal," will be a beginning in this much needed organization. When the clinical and urogenital examination indicates the type of focal invasion, this should also be qualified in the diagnosis.

Subdivision 3. *Intercurrent Infections.*—Intercurrent renal infections are almost always transitory and manifest as a rule only at the most active stage of the infection of origin, disappearing with convalescence. The kidney succumbs temporarily to organisms in overwhelming numbers. Included are those types of excretory focal nephritis occurring at the height of many infectious fevers—typhoid, scarlet, rheumatic, and relapsing fevers and pneumonia, measles, malaria and influenza, as well as other severe infections—as angina, tonsillitis, erysipelas, etc.

These infections are usually quite definite clinically and the term "pyelonephritis," intercurrent, with typhoid, influenza, etc., definitely characterizes the condition. Typhoid pyonephrosis is likewise specific.

III. THE UROGENITAL GROUP

In point of frequency, renal infections of accessory urogenital origin far outnumber infections of the specific and focal groups combined. So frequent and imminent are infections that the urologist must use the greatest care and precision with all methods of examination and treatment. Infection any place in the tract tends to spread to the kidney. Urinary stasis or obstruction is a common predisposing factor. Conditions of the focal group, particularly of the nonsuppurative subgroup of obscure infections, often coexist with urogenital conditions. Removal of the cause of obstruction may fail to clear the renal infection until a focus has been removed. But many renal infections are solely dependent on some accessory condition of the urogenital tract. Foci may be insignicant. The accessory conditions may be subdivided so that certain distinct clinical groups of renal infection will correspond with these subdivisions into (1) obstructive, (2) metastatic, (3) traumatic, and (4) transurethral conditions.

Subdivision 1. *Urinary Obstruction or Stasis.* As already stated, obstruction or stasis of urine anywhere in the tract is a common cause of renal infection by lowering renal resistance. The source of the organism is usually obscure. It may be of metastatic origin as in the focal group. It may reach the kidney by way of the blood stream through errors of intestinal hygiene. Bowel stasis or diarrhea may set colon bacilli free in the blood. A direct lymphatic path from the cecum to the right kidney is known anatomically, and at times the organism may follow this route. It may ascend from an infection of the lower tract by way of the ureteral lumen or such infections may feed organisms into the blood stream. These obstructions need not be continuous or prolonged. When temporary, as in vesical retention, infection may follow. For clinical reasons it is important to know whether the obstructive condition is of the lower tract, urethra and bladder, or of the upper tract, ureter and pelvis, and whether or not it is mechanical, adynamic or functional.

Not all of these infections are associated with changes of back pressure. Otherwise the term "infected hydronephrosis" could be generally applied. Pyelonephritis obstructive, however, is spe-

cific and designation of the location or type of obstruction would often much better qualify the pathological diagnosis.

Subdivision 2. *Metastatic Infection.*—It is a common experience in practice for infection of lower portions of the urogenital tract to spread to the kidney. By what route this invasion of the kidney occurs is not always at all clear. There may be some obstruction with lower tract infection that may be temporary or partial, as in many cases of prostatitis, so that in some cases an ascending invasion of the kidney may occur. Often the urogenital infection is not obstructive and then the invasion of the kidney is probably by way of the blood stream. At times several combination routes no doubt may occur to produce the renal infection. Because of the obscurity often present in these cases, designation of a metastatic pyelonephritis would have a definite meaning and the route of invasion is of little significance anyway. The term would specify that the infection of the kidney is secondary to infection in the urogenital tract, and the seat of this infection could often be designated to advantage as prostate, bladder, or ureter.

Subdivision 3. *Traumatic Infections.*—An infection will often arise in a kidney due to trauma from within, such as stone without obstruction, or to trauma or injury from without. In order to avoid confusion, the direct relation of trauma to the onset of infection should be clear. Many times trauma, such as a blow or fall, will precipitate an infection indirectly so that other etiological factors than trauma would have to be given due consideration in the diagnosis.

Subdivision 4. *Transurethral Infections.*—There are three definite types of transurethral invasion of the urogenital tract that often lead to renal infections. There can be no doubt that infection often ascends the short urethra of the female from the outside. The first effect, therefore, is an inflammation of the bladder or cystitis. How the infection reaches the kidney from the bladder is of little clinical importance. The source of the kidney infection has been the urethra and, therefore, prevention of recurrence of renal infection must be directed to the urethra. There are two distinct clinical types of ascending urethral infections which may be designated, first, the marital type, and second, the contamination type.

The marital type is directly related to intercourse. Trauma to the urethra enables organisms to ascend or they may be mechanically worked up the urethra at the time, setting up a definite cystitis. Defloration cystitis is probably identical with marital cystitis of this type and not to invasion of the blood stream by organisms from the torn hymen as was originally supposed. That the organisms can ascend the urethra either mechanically at the time of intercourse or later because of trauma to the urethra when produced seems proven by a number of clinical cases like the following:

The patient was a nurse and her husband a doctor, so that their statements and observations are of additional value. She had had recurring attacks of pyelonephritis which would invalid her for periods of two to six weeks once or twice a year for many years. She had been under treatment by pelvic lavage, ureteral dilatation, and general medical care for the elimination of all sorts of foci or other accessory causes. The urogenital tract on repeated examination appeared perfectly normal throughout. Ureteral dilatations had been followed vigorously without any permanent relief. Finally, the association of the onset of attacks to the marital relation was observed and precautionary measures instituted, such as vaginal douches before and the immediate instillation of a one per cent solution of mercurochrome into the bladder upon the first premonition of bladder irritation following intercourse. These prophylactic measures have prevented any attack of pyelonephritis of any kind for over four years.

The contamination type of ascending infection of the urethra must be common in many girl infants and, of course, prophylactic measures in regard to changing of diapers, douches, and local cleanliness are obvious. Such an explanation of some of the pyurias of childhood is supported by the greater frequency in girls and the fact that in about 50 per cent of these cases the infection is limited to the bladder, as proved by cystoscopy and ureteral catheterization, at onset or in the acute stage. With cystitis there is urinary dysfunction and all the factors necessary for a reflux to the kidney.

The third transurethral type of origin is instrumental. The urethral chill is probably a direct invasion, but in a very large percentage of cases inflammation of the kidney follows. Naturally organisms in the urethra that gain the blood stream sufficiently to produce chill could be carried by the same instrument into the bladder. It is, of course, well known that the normal bladder cannot be easily infected and, therefore, other associated lower tract conditions must be looked for in this type of case. The clinical designation of pyelonephritis transurethral is definite.

It is at once evident that one or more of the three clinical sources of infection may be associated. It is particularly common for urogenital and focal conditions to coexist, but it would seem a distinct clinical advantage to attempt a definite combined etiological-pathological classification and specify the presumptive renal lesion with its presumptive etiological factor. Specific, focal and urogenital pyelonephritides form three well marked definite groups of renal infection.

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DISCUSSION

DONALD A. CHARNOCK, M.D. (523 West Sixth Street, Los Angeles).—Infectious diseases of the urogenital system have long been unsatisfactorily catalogued. In this paper Doctor Hinman has dispensed with the necessity of philosophizing upon academic questions and has confined his classification to descriptive terms regarding the lesion itself.

The first class deals with the small group of specific invaders and needs no comment. The second group describes lesions which arise from infection present outside the urinary tract. Group three in-

cludes the various types initiated by infection present within the urinary tract.

The term "pyelitis" long ago came to be used as a general classification for any form of urinary infection. I do not think this gives us an adequate description of the many forms of infection within the urinary tract. In Doctor Hinman's classification, in addition to the type of lesion, we are given the method of invasion and also the area responsible for the infection. The value of this clear-cut classification is apparent when we consider the necessity for satisfactory hospital records and the opportunity for clearly defined descriptions in referring patients to other consultants. In place of classifying a lesion under the general term of pyelonephritis or pyelitis we can now say, for example: Transurethral pyelonephritis (instrumental) which will immediately explain the case as one of renal infection with the primary focus in the urethra due to instrumentation.

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CHARLES P. MATHÉ, M. D. (450 Sutter Street, San Francisco).—We are greatly indebted to Doctor Hinman for his comprehensive clinical classification of renal infections into three distinct groups, viz., specific, focal, and urogenital. The necessity of classification at the present time is indeed very great in order that urologists may have a mutual understanding of how to classify the various infections that we encounter daily in the kidney.

The diagnosis of the focal group of coccal infection of the kidney; acute suppurative nephritis, single and multiple cortical abscess formation and renal carbuncle and those of the renal loge, paranephritis, perinephritic abscess, etc., has always been quite obscure because of the paucity of urinary findings as compared to the severity of the patient's illness. In these cases very little evidence of infection can be found in making a routine examination of the urine. It has been my experience, however, that centrifugalization of the urine collected over a long period of time will often reveal the invading staphylococcus and is of great significance in aiding in the diagnosis of these lesions. They are more often found in cortical lesions of the kidney and less readily encountered if the infection is in the perinephritic tissues. In these cases the history of preëxisting foci in the skin, such as boils, furuncles, carbuncles, paronychia, etc., is of great significance. If the infected embolus lodges in the end arteries of the glomeruli, suppurative nephritis, cortical abscess, or renal carbuncle results. On the other hand, if the staphylococci lodge in the terminal arteries in the perirenal fat, perinephritic abscess develops. Perinephritic abscess may also be formed from direct extensions of a cortical abscess through the kidney capsule or by way of the lymphatics. The significance of early diagnosis of acute suppurative nephritis was pointed out by Brewer in 1906, who recommended early nephrectomy before involvement of the opposite kidney had taken place. It is very important to distinguish between acute suppurative hematogenous nephritis due to the staphylococcus and severe acute pyelonephritis due to the colon bacillus. Early nephrectomy is usually always indicated in the former, whereas renal drainage and lavage through the ureteral catheter is adequate in the latter.

The great incidence of infection of the urethra, prostate and seminal vesicles favor renal infection, often acting as a focus of pyelonephritis. This was strongly emphasized by Professor von Lichtenberg and myself in papers delivered before the American Urological Association in 1929. The relation of infections of the gastro-intestinal tract, gall-bladder, appendix, etc., has long been realized and this entro-renal syndrome was strongly emphasized by Heitz-Boyer a number of years ago. Any treatment directed to relieve renal infection, in order to be efficacious must also be directed toward eradicating all possible foci of infection elsewhere in the body.

Doctor Hinman has done well to emphasize the rôle of congenital and acquired urinary obstruction and stasis in the production of renal infection. Back pressure in the kidney not only may lower its local resistance, making it more susceptible to infection, but may also cause invasion of the renal cortex by organisms that had existed in the pelvis and collecting tubules for years. Thus, a pyelonephritic infection which had not been severe and had caused little appreciable damage to the kidney may extend to its periphery and invade the parenchyma forming numerous abscesses which result in destruction of this organ, thus necessitating nephrectomy.

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LIONEL P. PLAYER, M. D. (384 Post Street, San Francisco).—The author's classification gives surgeons a means of communicating their findings and diagnoses clearly and intelligently. Doctor Hinman's paper is the most concise and comprehensive, yet simple of any offered, to my knowledge, in the literature, and I wish to express my appreciation of his very excellent contribution.

An outline for the classification of urinary infections, may I suggest, should embody the following:

1. Type or types of organisms.
2. Origin of organisms, *i. e.,* skin, sinuses, tonsils, etc.
3. Mode of invasions, *i. e.,* hematogenous, lymphogenous by continuity of tissue or from contiguous tissues.
4. Areas or points infected in the particular organ attacked by these organisms or their toxins.
5. Effect on the organ itself.
6. Effect on contiguous and connecting structures and the general system.
7. Previous knowledge of the general or selective action of these bacteria and their toxins. With these data in mind in a classification as an aid to the various methods of diagnosis, the more apparent and also the obscure lesions due to urinary infections would be recognized more readily.

LENGTHENING OF THE LOWER EXTREMITIES*

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DISCUSSION *by George H. Sanderson, M. D., Stockton; H. D. Barnard, M. D., Los Angeles; S. L. Haas, M. D., San Francisco.*

THE purpose of this article is to describe methods of operative lengthening of the bones of the lower extremity which were developed by the writer † at the Shriners' Hospital for Crippled Children in St. Louis. During the past six years these methods were used in a series of seventy-three children in whom shortening was due to infantile paralysis, congenital malformation, and destructive disease of the hip and knee joints. In forty-eight cases the tibia and fibula were lengthened, while in the remaining twenty-five cases the lengthening was done on the femur. The experience gained in this group of patients has been interesting and profitable, and the results have been decidedly encouraging.

These methods are based on three fundamental principles of bone lengthening, which are as follows: (1) To lengthen the bone, traction and countertraction must be taken directly upon that bone; (2) to overcome the elastic resistance of the soft parts, this traction must be of the slow,

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